1729. (amended) The method of claim 1727, further comprising maintaining a temperature in the part of the formation in a pyrolysis temperature range from about 270 °C to about 400 °C.

1730. (amended) The method of claim 1727, wherein at least one of the one or more heaters comprises an electrical heater.

1731. (amended) The method of claim 1727, wherein at least one of the one or more heaters comprises a surface burner.

1732. (amended) The method of claim 1727, wherein at least one of the one or more heaters comprises a flameless distributed combustor.

1733. (amended) The method of claim 1727, wherein at least one of the one or more heaters comprises a natural distributed combustor.

1734. (amended) The method of claim 1727, further comprising controlling a pressure and a temperature in at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

1735. (amended) The method of claim 1727, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range of about 270 °C to about 400 °C.

1736. (amended) The method of claim 1727, wherein providing heat from the one or more heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from the one or more heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons in the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

1738. (amended) The method of claim 1727, wherein allowing the heat to transfer to the part of the formation heats the part of the formation to increase a thermal conductivity of at least a portion of the part of the formation to greater than about 0.5 W/(m °C).

1750. (amended) The method of claim 1727, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

1753. (amended) The method of claim 1727, further comprising controlling a pressure in at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bars absolute.

1754. (amended) The method of claim 1727, further comprising controlling formation conditions to produce the mixture, wherein a partial pressure of H_2 in the mixture is greater than about 0.5 bar.

1755. (amended) The method of claim 1754, wherein the partial pressure of H_2 in the mixture is measured when the mixture is at a production well.

1756. (amended) The method of claim 1727, further comprising altering a pressure in the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25.

1758. (amended) The method of claim 1727, further comprising:

providing hydrogen (H_2) to the part of the formation to hydrogenate hydrocarbons in the part of the formation; and

heating a portion of the part of the formation with heat from hydrogenation.

1760. (amended) The method of claim 1727, wherein allowing the heat to transfer increases a permeability of a majority of the part of the formation to greater than about 250 millidarcy.

1761. (amended) The method of claim 1727, wherein allowing the heat to transfer increases a permeability of a majority of the part of the formation such that the permeability of the majority of the part is substantially uniform.

1766. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:
providing heat from one or more heaters to at least a portion of the formation;
allowing the heat to transfer from the one or more heaters to a part of the formation;
wherein at least some hydrocarbons in the part of the formation have an initial total organic matter weight percentage of at least about 5.0%; and
producing a mixture from the formation.

1768. (amended) The method of claim 1766, further comprising maintaining a temperature in the part of the formation in a pyrolysis temperature range from about 270 °C to about 400 °C.

1769. (amended) The method of claim 1766, wherein at least one of the one or more heaters comprises an electrical heater.

1770. (amended) The method of claim 1766, wherein at least one of the one or more heaters comprises a surface burner.

1771. (amended) The method of claim 1766, wherein at least one of the one or more heaters comprises a flameless distributed combustor.

1772. (amended) The method of claim 1766, wherein at least one of the one or more heaters comprises a natural distributed combustor.

1773. (amended) The method of claim 1766, further comprising controlling a pressure and a temperature in at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

1774. (amended) The method of claim 1766, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range of about 270 °C to about 400 °C.

1775. (amended) The method of claim 1766, wherein providing heat from the one or more heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from the one or more heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons in the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

1777. (amended) The method of claim 1766, wherein allowing the heat to transfer to the part of the formation heats the part of the formation to increase a thermal conductivity of at least a portion of the part of the formation to greater than about 0.5 W/(m °C).

1789. (amended) The method of claim 1766, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

1792. (amended) The method of claim 1766, further comprising controlling a pressure in at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bars absolute.

1793. (amended) The method of claim 1766, further comprising controlling formation conditions to produce the mixture, wherein a partial pressure of H_2 in the mixture is greater than about 0.5 bar.

1794. (amended) The method of claim 1793, wherein the partial pressure of H_2 in the mixture is measured when the mixture is at a production well.

1795. (amended) The method of claim 1766, further comprising altering a pressure in the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25.

1797. (amended) The method of claim 1766, further comprising:

providing hydrogen (H_2) to the part of the formation to hydrogenate hydrocarbons in the part of the formation; and

heating a portion of the part of the formation with heat from hydrogenation.

1799. (amended) The method of claim 1766, wherein allowing the heat to transfer increases a permeability of a majority of the part of the formation to greater than about 250 millidarcy.

1800. (amended) The method of claim 1766, wherein allowing the heat to transfer increases a permeability of a majority of the part of the formation such that the permeability of the majority of the part is substantially uniform.

5398. (new) The method of claim 1727, further comprising providing H_2 to the part of the formation.

5399. (new) The method of claim 1727, further comprising providing H_2 to the part of the formation to hydrogenate hydrocarbons in the formation.

5400. (new) The method of claim 1766, further comprising providing H_2 to the part of the

formation.

5401. (new) The method of claim 1766, further comprising providing H_2 to the part of the formation to hydrogenate hydrocarbons in the formation.

5402. (new) A method of treating a hydrocarbon containing formation in situ, comprising:

providing heat from heaters positioned in heater wells to at least a portion of the formation;

allowing the heat to transfer from the heaters to a part of the formation;

wherein at least some of the part of the formation comprises a total organic matter weight percentage of at least about 5.0 %; and

producing a mixture from the formation.

5403. (new) The method of claim 5404, further comprising providing H_2 to the part of the formation.

5404. (new) The method of claim 5404, further comprising providing H_2 to the part of the formation to hydrogenate hydrocarbons in the formation.

Response

A. Pending Claims

Claims 1727-1804, and 5396-5407 are pending in the case. Claims 1728-1736, 1738, 1750, 1753-1756, 1758, 1760, 1761, 1766, 1768-1775, 1777, 1789, 1792-1795, 1797, 1799, and 1800 have been amended. Claims 1728-1736, 1738, 1750, 1753-1756, 1758, 1761, 1766, 1768-1775, 1777, 1789, 1792-1795, 1797, and 1800 have been amended for clarification and/or correction of typographical errors. Claims 5398-5404 are new.

B. Provisional Double Patenting Rejection

Applicant acknowledges the Examiner's agreement to suspend the double patenting rejections until the claims are in condition for allowance but for the double patenting rejection.

C. The Claims Are Not Anticipated By Tsai et al. Pursuant To 35 U.S.C. § 102(b)

The Examiner rejected claims 1727, 1729, 1732, 1733, 1737, 1753, 1760-1762, 1766, 1768, 1771, 1776, 1792, and 1799-1801 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,299,285 to Tsai et al. (hereinafter "Tsai"). Applicant respectfully disagrees with these rejections.

The standard for "anticipation" is one of fairly strict identity. To anticipate a claim of a patent, a single prior source must contain all the claimed essential elements. *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 231 U.S.P.Q.81, 91 (Fed.Cir. 1986); *In re Donahue*, 766 F.2d 531, 226 U.S.P.Q. 619, 621 (Fed.Cir. 1985).

The Examiner states:

> With regards to independent claims 1727 and 1766; applicant has argued that the Tsai reference fails to teach or suggest "providing heat from one or more heaters to at least a portion of the formation". Applicant also

> provides text from the specification to support a definition of "heater", which would exclude the fire taught by Tsai.
>
> It is noted that applicant's specification also includes much broader definitions of "heater", which include fire....

The Examiner quotes from page 3, lines 20-28 of the Specification. Applicant respectfully disagrees with the Examiner's characterization of Applicant's Specification. The portion of Applicant's Specification that the Examiner cited is under the section "Description of Related Art". The description of related art describes to the extent practical the state of the prior art or other information disclosed known to the applicant. MPEP 608.01(c). The description of a heater cited from page 40 of the Applicant's Specification is from the Specification section titled "Detailed Description of the Invention". An applicant may be his or her own lexicographer. *In re Hill*, 161 F.2d 367, 73 U.S.P.Q. 482 (C.C.P.A. 1947); MPEP 2111.01.

Applicant submits that a "heater" has been described at least on page 40 of the Applicant's Specification. When a specification provides definitions for terms appearing in the claims, the specification can be used in interpreting claim language. *In re Vogel*, 422 F.2d 438, 441, 164 U.S.P.Q. 619, 622 (C.C.P.A. 1970); MPEP 2111.01. The Examiner agrees that the "text from the specification...support[s] a definition of 'heater', which would exclude the fire taught by Tsai." Thus, since the Applicant has described a "heater" at least on page 40 of Applicant's Specification and the Examiner has agreed that the definition does exclude the method taught by Tsai, Applicant respectfully requests the removal of the rejections of claims 1727 and 1766 and the claims dependent thereon. Applicant further submits that many of the claims dependent on claims 1727 and 1766 are separately patentable.

Amended claims 1732 and 1771 describe a combination of features including: "wherein at least one of the one or more heaters comprises a flameless distributed combustor." The Examiner states: "With regards to claim 1732; the Tsai reference teaches a flameless combustor (see col. 2, line 32)." The Examiner further states: "With regards to claim 1771; the Tsai reference teaches a flameless combustor (see col. 2, line 32)."

In reference to flameless combustion, Applicant's Specification teaches:

> Flameless combustion may be accomplished by preheating a fuel and combustion air to a temperature above an auto-ignition temperature of the mixture. The fuel and combustion air may be mixed in a heating zone to combust. In the heating zone of the flameless combustor, a catalytic surface may be provided to lower the auto-ignition temperature of the fuel and air mixture. (Specification, page 4, lines 2-6)

Applicant's Specification also teaches:

> FIG. 28 illustrates an embodiment of a flameless combustor configured to heat a section of the hydrocarbon containing formation. (Specification, page 119, lines 7-8)

> Oxidation of fuel fluid 621 may provide heat generation within outer conduit 636. The generated heat may provide heat to at least a portion of a hydrocarbon containing formation proximate to the oxidation region of inner conduit 638. Products 625 from oxidation of fuel fluid 621 may be removed through outer conduit 636 outside inner conduit 638. (Specification, page 119, line 28 to page 120, line 2)

Amended claims 1733 and 1772 describe a combination of features including: "wherein at least one of the one or more heaters comprises a natural distributed combustor." The Examiner states: "With regards to claim 1733; the Tsai reference teaches a natural distributed combustor (see col. 2, line 32)." The Examiner further states: "With regards to claim 1772; the Tsai reference teaches a natural distributed combustor (see col. 2, line 32)."

Applicant's Specification teaches, in reference to a natural distributed combustor:

> As used herein, the phrase "natural distributed combustor" generally refers to a heater that uses an oxidant to oxidize at least a portion of the carbon in the formation to generate heat, and wherein the oxidation takes place in a vicinity proximate to a wellbore. Most of the combustion products produced in the natural distributed combustor are removed through the wellbore. (Specification, page 40, lines 19-24)

> Although the heat from the oxidation is transferred to the formation, oxidation product 519 (and excess oxidation fluid such as air) may be substantially inhibited from flowing through the formation and/or to a production well within formation 516. Instead oxidation product 519 (and

> excess oxidation fluid) is removed (e.g., through a conduit such as conduit 512) as is described herein. In this manner, heat is transferred to the formation from the oxidation but exposure of the pyrolysis zone with oxidation product 519 and/or oxidation fluid may be substantially inhibited and/or prevented. (Specification, page 77, lines 18-24)

Tsai does not appear to teach a heater such as a natural distributed combustor or a flameless combustor. Tsai appears to teach starting a fire in the coal bed. Tsai states, "the oxidizing gas is injected into the injection hole at an appropriate rate and the fire is started in the coal bed at the injection well." (Tsai, col. 2, lines 31-34) Applicant submits that the combinations of features in claims 1732, 1733, 1771, and 1772 do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejections of claims 1732, 1733, 1771, and 1772.

The Examiner states in regards to claims 1737 and 1776:

> the Tsai reference does not explicitly teach the transferring by conduction; however this is inherent in a solid substance such as coal. Even though the bulk of the heating in the Tsai method may be done by convection; it is apparent that some unfractured coal must remain, and thus allowing heat to transfer comprises transferring heat substantially by conduction (that is, substantially within the unfractured portions).

The Examiner also states "[i]t should be abundantly clear that heat transfer in a solid substance such as coal inherently includes conduction."

Claims 1737 and 1776 describe a combination of features including, but not limited to, "wherein allowing the heat to transfer comprises transferring heat substantially by conduction." The Examiner states: "the bulk of the heating in the Tsai method may be done by convection...." "Substantially" is defined as "largely; essentially; in the main." (*Webster's New Twentieth Century Dictionary Unabridged, 2nd ed.*) Since Tsai teaches largely or essentially heating by convection, transferring heat substantially by conduction is precluded. Therefore, Tsai does not appear to teach or suggest all the features of claims 1737 and 1776. Applicant respectfully requests removal of the rejections of claims 1737 and 1776.

The Examiner states: "With regards to claim 1753, the Tsai reference teaches the pressure greater than 2.0 bar." The Examiner further states: "With regards to claim 1792, the Tsai reference teaches the pressure greater than 2.0 bar." Tsai states: "Air is heated to a temperature of about 250 °C and is injected into the injection well at a pressure of approximately 500 psi.... Combustion air at ambient temperature is now injected into the injection hole at a pressure of 50 psi...." (Tsai, col. 7, line 62-col. 8, line 11)

Amended claims 1753 and 1792 describe a combination of features including: "controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bars absolute." Applicant submits that Tsai does not appear to teach or suggest controlling a pressure within a formation or within at least a majority of a part of a formation. Tsai appears, instead, to teach a pressure of air injected into a formation. At least the above-quoted features of the claims, in combination with other features of the claims, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejections of claims 1753 and 1792.

The Examiner states: "With regards to claims 1760 [1799] and 1761 [1800]; the Tsai reference teaches the permeability greater than about 100 md in table 1. The uniform increase in permeability is inherent." Contrary to the Examiner's statement that "applicant has failed to provide any evidence that the uniform increase of permeability is not inherent," Applicant submits that, in relying upon the theory of inherency, the Examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art. In some situations, heating caused by a fireflood may increase permeability in local areas through which the fireflood has passed, but such heating will not result in a uniform increase in permeability.

Amended claims 1760 and 1799 describe a combination of features including: "wherein allowing the heat to transfer increases a permeability of a majority of the part of the formation to greater than about 250 millidarcy." Support for amendments to the claims is found in the Specification as follows:

> Permeability of a selected section within the heated portion of the hydrocarbon containing formation may also rapidly increase while the selected section is heated by conduction. For example, permeability of an impermeable hydrocarbon containing formation may be less than about 0.1 millidarcy (9.9 x 10^{-17} m^2) before treatment. In some embodiments, pyrolyzing at least a portion of a hydrocarbon containing formation may increase a permeability within a selected section of the portion to greater than about 10 millidarcy, 100 millidarcy, 1 Darcy, 10 Darcy, 20 Darcy, or 50 Darcy. Therefore, a permeability of a selected section of the portion may increase by a factor of more than about 1,000, 10,000, or 100,000. (Specification, page 151, line 28-page 152, line 5)

Applicant submits at least the above-quoted features of claims 1760 and 1799, in combination with other features of the claims, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejections of claims 1760 and 1799.

Amended claims 1761 and 1800 describe a combination of features including: "wherein allowing the heat to transfer increases a permeability of a majority of the part of the formation such that the permeability of the majority of the part is substantially uniform."

Permeabilities recorded in Table I of Tsai do not appear to be substantially uniform. Tsai states: "The initial permeability of the core was 2.0, after two days it was 27.5, after three days it was 77.2 and after four days it was 107 as reported in Table I." (Tsai, col. 7, lines 11-14) In addition, Table I of Tsai discloses a permeability of 107 md for Ex. 6 and a permeability of 148 md for Ex. 7, in which the axis of the core was perpendicular to the bedding plane. Tsai also states: "It should be appreciated that the coal, following the pretreatment and conditioning procedure, will exhibit a zone of increasing free swelling index and a decreasing permeability in a direction away from the fracture-induced linkage until non-affected coal is reached." (Tsai, col. 5, lines 32-37) Applicant submits at least the above-quoted features of claims 1761 and 1800, in combination with other features of the claims, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejections of claims 1761 and 1800.

Claims 1762 and 1801 describe a combination of features including: "controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by the Fischer Assay." The Examiner states: "With regards to claim 1762 [1801]; although the Tsai reference fails to explicitly disclose a Fischer Assay; it is apparent that the disclosed process will yield greater than 60%." Applicant submits that features of claims 1762 and 1801 do not appear to be taught or suggested by the cited art. In relying upon the theory of inherency, the Examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art. Otherwise, Applicant respectfully requests removal of the rejections of claims 1762 and 1801.

D. The Claims Are Not Obvious Over Tsai Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1728, 1730, 1731, 1738-1750, 1754, 1755, 1767, 1769, 1770, 1777-1789, 1793, and 1794 under 35 U.S.C. § 103(a) as being unpatentable over Tsai. Applicant respectfully disagrees with these rejections.

In order to reject a claim as obvious, the Examiner has the burden of establishing a *prima facie* case of obviousness. *In re Warner et al.*, 379 F.2d 1011, 154 USPQ 173, 177-178 (CCPA 1967). To establish a *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP § 2143.03.

If an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). For at least the reasons cited in Section C, independent claims 1727 and 1766 are not obvious over the cited art. Applicant respectfully requests removal of the rejections of claims 1728, 1730, 1731, 1738-1750, 1754, 1755, 1767, 1769, 1770, 1777-1789, 1793, and 1794. Applicant further submits that many of the rejected claims are separately patentable.

The Examiner states: "With regards to claims 1738 and 1777.... it would have been

further obvious to one of ordinary skill in the art at the time of the invention to have practiced the Tsai method in a coal seam having a thermal conductivity of greater than about 0.5 W/(m °C) as called for in claims 1738 and 1777". Applicant submits that practicing the Tsai method in a coal seam having a thermal conductivity of greater than about 0.5 W/(m °C) is not equivalent to "allowing the heat to transfer to the part of the formation heats the part of the formation to increase a thermal conductivity of at least a portion of the part of the formation to greater than about 0.5 W/(m °C)", as recited in amended claims 1738 and 1777. Applicant submits that features of claims 1738 and 1777 are unexpected based on literature in the art. For example, Applicant's Specification states:

> Certain embodiments described herein will in many instances be able to economically treat formations that were previously believed to be uneconomical. Such treatment will be possible because of the surprising increases in thermal conductivity and thermal diffusivity that can be achieved with such embodiments. These surprising results are illustrated by the fact that prior literature indicated that certain hydrocarbon containing formations, such as coal, exhibited relatively low values for thermal conductivity and thermal diffusivity when heated. For example, in government report No. 8364 by J. M. Singer and R. P. Tye entitled "Thermal, Mechanical, and Physical Properties of Selected Bituminous Coals and Cokes," U.S. Department of the Interior, Bureau of Mines (1979), the authors report the thermal conductivity and thermal diffusivity for four bituminous coals. This government report includes graphs of thermal conductivity and diffusivity that show relatively low values up to about 400 °C (e.g., thermal conductivity is about 0.2 W/(m °C) or below, and thermal diffusivity is below about 1.7 x 10^{-3} cm^2/s). This government report states that 'coals and cokes are excellent thermal insulators.'
>
> In contrast, in certain embodiments described herein hydrocarbon containing resources (e.g., coal) may be treated such that the thermal conductivity and thermal diffusivity are significantly higher (e.g., thermal conductivity at or above about 0.5 W/(m °C) and thermal diffusivity at or above 4.1 x 10^{-3} cm^2/s) than would be expected based on previous literature such as government report No. 8364. If treated as described in certain embodiments herein, coal does not act as 'an excellent thermal insulator.' Instead, heat can and does transfer and/or diffuse into the formation at significantly higher (and better) rates than would be expected according to the literature, thereby significantly enhancing economic viability of treating the formation.
> (Specification, page 150, line 18 to page 151, line 10)

Applicant submits that at least the above-quoted features of claims 1738 and 1777 are not taught or suggested by the combination of the prior art. Applicant respectfully requests removal of the

rejections of claims 1738 and 1777.

E. The Claims Are Not Obvious Over Tsai In View Of Kasevich et al. Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1735, 1736, 1774, and 1775 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,457,365 to Kasevich et al. (hereinafter "Kasevich"). Applicant respectfully disagrees with these rejections.

Amended claims 1735 and 1774 describe a combination of features including: "controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range of about 270 °C to about 400 °C."

Kasevich states: "this invention provides for heating kerogen in oil shale with electric fields having frequency components in the range between 100 kilohertz and 100 megahertz where dry oil shale is selectively heated, with kerogen-rich regions absorbing energy from said fields at substantially higher rates than kerogen-lean regions." (Kasevich, col. 2, lines 9-15)

Tsai states: "This invention relates to the in situ combustion and gasification of a swelling bituminous coal by the injection of air for combustion into the coal bed from one or more injection holes and the production of a combustible gas from one or more production holes." (Tsai, col. 1, lines 6-10)

Obviousness can only be established by "showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teaching of the references." *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). Applicant respectfully submits that the features of the electric field heating method of Kasevich for an oil shale formation would not be suitable for modifying the in situ combustion process of Tsai for a coal formation to produce the features described in claims 1735, 1736, 1774, and 1775.

The Examiner states: "since the increase of temperature stops, the heating must inherently comprise a rate of increase less than than 1.6°C." Kasevich states: "Thus, if the kerogen were heated from 150 °C. to 500 °C. at the rate of 50 °C./month, the absorption rate would approximate that of curve 114 [in Figure 3], while more rapid heating rates would produce curves 120, 122 and 124 for heating rates of 50 °C. per month, 50 °C./day, 50 °C./hour and 50 °C./minute, respectively" (Kasevich, col. 8, lines 57-62).

Figure 3 of Kasevich shows a heating rate of 50 °C/month, which may correspond to an average heating rate of about 1.6 °C/day. Kasevich, however, does not appear to teach or suggest the features of amended claims 1735 and 1774 including: "controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range of about 270 °C to about 400 °C." At least the above-quoted features of claims 1735 and 1774, in combination with other features of the claims, do not appear to be taught or suggested by a combination of the cited art. Applicant respectfully requests removal of the rejections of claims 1735 and 1774.

The Examiner states:

> With regards to claims 1736 and 1775; it is known to heat at rates of less than 10°C per day, as shown by Kasevich (figure 3). It is apparent that this low heating rate is desirable because it results in more uniform heating, and reduces the possibility of hot spots. It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included heating at a rate of less than about 10°C per day as called for in claims 1736 and 1775 in order to achieve more uniform heating. The claim limitations drawn to the heating energy are nothing more than well known thermodynamic equations.

The Examiner further states: "the claims do not call for 'using a desired heating rate to calculate a maximum amount of heating'." Applicant respectfully disagrees with the Examiner's characterization of claims 1736 and 1775. Amended claims 1736 and 1775 describe a combination of features including: "wherein heating energy/day (*Pwr*) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an

average heating rate (*h*) of the selected volume is about 10 °C/day." The claims describe heating energy/day (*Pwr*) provided to the selected volume. The heating energy/day (*Pwr*) provided to the selected volume is equal to or less than a product of the average heating rate, the selected volume, the average heat capacity of the formation, and the formation bulk density. For a selected volume of a formation, the average heating energy/day required to achieve a desired average heating rate (in this case about 10 °C/day) may be calculated and applied to the selected volume. The calculated average heating energy/day will be the maximum average heating energy/day that may be applied to the formation without exceeding the desired average heating rate. Applicant respectfully maintains that the combination of Tsai and Kasevich does not appear to teach or suggest using a desired heating rate to calculate a maximum average heating energy/day to be applied to a selected volume of a formation. Applicant respectfully requests removal of the rejections of claims 1736 and 1775.

F. The Claims Are Not Obvious Over Tsai In View of Stoddard et al. Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1751, 1752, 1790, and 1791 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,463,807 to Stoddard et al. (hereinafter "Stoddard"). Applicant respectfully disagrees with these rejections.

The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). Applicant submits that there does not appear to be any evidence to support the desirability of a combination of Tsai and Stoddard. Thus, the Examiner's rejection appears to be based on improper hindsight reasoning. While it may be "well known that ammonia is a byproduct of such heating of coal", as stated by the Examiner, the combination of Tsai and Stoddard does not appear to teach or suggest the desirability of producing a mixture comprising ammonia from a hydrocarbon containing formation and/or using ammonia from a mixture produced from a hydrocarbon containing formation to produce fertilizer. Applicant respectfully requests removal of the rejections of claims 1751, 1752, 1790, and 1791.

G. The Claims Are Not Obvious Over Tsai In View of Gregoli et al. Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1756-1759 and 1795-1798 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 6,016,867 to Gregoli et al. (hereinafter "Gregoli"). Applicant respectfully disagrees with these rejections.

The Examiner states:

> The Tsai reference fails to teach the recirculating hydrogen, providing hydrogen, or hydrogenating. The Gregoli reference teaches that in a similar in-situ processes, it is beneficial to use hydrogen to hydrogenate heavy hydrocarbons.... It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included recirculating hydrogen as called for in claims 1757 and 1796; providing hydrogen as called for in claims 1758 and 1797; and hydrogenating as called for in claims 1759 and 1798; in order to reduce the heavy hydrocarbons and to improve production.

Figure 1 of Gregoli depicts injection of hydrogen into the reservoir by way of the injection-well borehole. Gregoli does not appear to teach or suggest features of claims 1757 and 1796 including: "controlling formation conditions by recirculating a portion of hydrogen from the mixture into the formation." Gregoli does not appear to teach or suggest features of claims 1759 and 1798 including: "producing hydrogen and condensable hydrocarbons from the formation; and hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen." Applicant submits that the Examiner is extending the teaching of Gregoli in the obviousness rejection of claims 1757, 1759, 1796, and 1798. Applicant respectfully requests removal of the rejections of claims 1757, 1759, 1796, and 1798.

H. The Claims Are Not Obvious Over Tsai In View of Van Meurs et al. Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1763, 1764, 1802, 1803, 5396, and 5397 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,886,118 to Van Meurs et al.

(hereinafter "Van Meurs"). Applicant respectfully disagrees with these rejections.

Van Meurs states:

> Even with respect to a five-spot pattern in which a single fluid-producing well is surrounded by four heat-injecting wells, substantially all of the intervening oil shale can be both retorted and made permeable. However, the present invention is preferably employed in a series of contiguous seven—or thirteen-spot patterns—in either of which patterns (particularly in the thirteen-spot pattern) and retorting rate is significantly increased by having each fluid producing well surrounded by six or twelve heat-injecting wells. (Van Meurs, col. 8, lines 15-24)

Van Meurs appears to teach three discrete patterns for heat-injecting wells. Van Meurs does not appear to teach or suggest a range of heaters for each production well. In particular, Van Meurs does not appear to teach or suggest features of claims 5396 and 5397 including: "wherein at least about 20 heaters are disposed in the formation for each production well." Applicant submits that the Examiner is extending the teaching of Van Meurs in the obviousness rejection of claims 5396 and 5397. Applicant respectfully requests removal of the rejections of claims 5396 and 5397.

I. New Claims

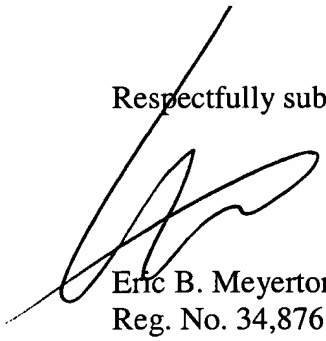
New claims 5398 and 5399, which are dependent claims of claim 1727, include features described at least in claim 1758. New claims 5400 and 5401, which are dependent claims of claim 1766, include features described at least in claim 1797. New claim 5402 includes features of claim 1727 and the added feature of "one or more heaters positioned in heater wells... wherein at least some of the part of the formation comprises a total organic matter weight percentage of at least about 5.0 %". Support for the added feature is found in the Specification at least on page 40, lines 6-11. The above quoted feature of claim 5402, in combination with the other features of the claim, does not appear to read on the cited art. New claims 5403 and 5404 include features described at least in claims 1758 and 1797.

J. Additional Comments

Applicant submits that all claims are in condition for allowance. Favorable consideration is respectfully requested.

A Fee Authorization is enclosed to cover the fees associated with the filing of a Request for Continued Examination, a one-month extension of time, and additional claims. If any further extension of time is required, Applicant hereby requests the appropriate extension of time. If any additional fees are required or if fees have been overpaid, please appropriately charge or credit those fees to Meyertons, Hood, Kivlin, Kowert & Goetzel, P.C. Deposit Account Number 50-1505/5659-03800/EBM.

Respectfully submitted,



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